DOCUMENT RESUME

ED 265 335 CE 043 272

TITLE	Printed Circuitboard: Design and Production. Youth Training Scheme. Core Exemplar Work Based Project.
INSTITUTION	Further Education Staff Coll., Blagdon (England).
REPORT NO	ISBN-0-948361-40-9
PUB DATE	84
NOTE	21p.; Portions printed on colored paper. For other guides in this series, see CE 043 245-288.
PUB TYPE	Guides - Classroom Use - Guides (For Teachers) (052) -- Guides - Classroom Use - Materials (For Learner) (051)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	Behavioral Objectives; Competency Based Education; Core Curriculum; *Electric Circuits; *Electronics; *Electronic Technicians; Equipment Utilization; Foreign Countries; Job Skills; Learning Activities; Learning Modules; *Manufacturing; Measurement Equipment; On the Job Training; Postsecondary Education; Records (Forms); *Technical Education; *Work Experience Programs
IDENTIFIERS	England; *Printed Circuit Boards

ABSTRACT

This trainer's guide is intended to assist supervisors of work-based career training projects in teaching students the following aspects of producing printed circuit boards: planning and drawing circuit diagrams, using the equipment and tools needed to produce printed circuit boards, using an oscilloscope and probes, calculating the cost of a parts kit, and writing a technical report. The guide is one in a series of core curriculum modules that is intended for use in combination on- and off-the-job programs to familiarize youth with the skills, knowledge, and attitudes necessary for success in the workplace. Included in the guide are the following components: project information, a summary of the content and approach of the guide, supervisor's notes, lists of tasks and core skills, an action plan that includes suggested learning activities, supervisor and trainee review sheets, and an assessment form. (MN)

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Youth Training Scheme

CORE EXEMPLAR WORK BASED PROJECT

ED265335

Printed circuit board: Design and production

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CE043212

OTF No: 5

PROJECT No: Y|41

TYPE Individual

ESF
CORE SKILLS PROJECT
YTS

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ISBN 0-948361-40-9

ASSESSMENT OF CORE SKILLS

This series of projects contains a number of different formats for recording assessment of core skills. These formats are offered for experimental purposes; none is proven as the 'best' method. All are based on the principle that feedback to trainees is a necessary part of the learning process and that such feedback should include information on core skill development.

Further work is being carried out on the methods of assessing achievement of core skills in work-based learning and of how to log such achievement on a record which trainees can take away from YTS. Some of the results of this work will be included in later MSC/ESF Core Skills Project publications.

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INTRODUCTION

WHAT ARE WORK-BASED PROJECTS?

Work-based projects are learning materials which aim to make the most of all the possibilities for developing trainees' skills, knowledge and attitudes in the workplace. They build upon everyday workplace tasks to provide experience of the whole range of YTS learning opportunities.

The projects in this series have been tested with managing agents as part of the YTS Core Project, which is jointly financed by MSC and the European Social Fund. In some cases managing agents will be able to use the projects as they are. In others they will need to be adapted to the circumstances of a particular workplace or to the aims of a particular scheme. Some managing agents will prefer to produce their own projects. For such cases these examples aim to demonstrate some principles of good design in work-based learning materials. These principles are:

To encourage trainees to learn by doing
To make the most of all the experiences which are available to trainees in the workplaces.
To start from a real task which is seen as relevant by all parties involved — trainees, workplace supervisors, trainers and off-the-job tutors.
To help trainees see the relationships between things learnt on- and off-the-job.
To base the assessment of achievement upon trainees' actual performance in tasks.
To look for all the opportunities for learning which arise from a task and, in particular, to help trainees to develop the core skills. These skills, in number, communication, problem-solving and practical activities, are used in a wide variety of tasks and are essential if trainees are to achieve competence in those tasks*. They are the skills — of finding out information, planning how to do things, overcoming difficulties and so on — which help trainees to learn more quickly in new situations, either in the same workplace, in a different one, or in the world outside work.

Such skills are required naturally by the workplace tasks in these projects and, in requiring trainees to go beyond the task itself, the projects deliberately *add* to the range of core skills which are required in an everyday working situation. This is especially important for some of the skills of communication and problem-solving which trainees are often not given the opportunity to exercise in work experience.

These principles can be incorporated in projects for all placements and for trainees of all ability levels. Although the projects in this series follow a common format, there is no single 'best' style. Nor is any special expertise in writing necessary. Good work-based projects can be produced by anyone who is determined to help trainees to exploit all of the potential for learning in work experience.

*A technical manual 'Core Skills in YTS' is currently available from MSC. It is supported by a short introductory leaflet and a practitioner's guide for supervisors. A separate manual is available on computer literacy/information technology.

PROJECT INFORMATION

This project is designed for a trainee taking an electronics module at an ITeC who has previously produced PCBs, assembled boards and components and used oscilloscopes and other equipment to test various circuits.

Though the project deals with a practical task, it is not intended to be purely a practical training exercise. It aims, rather, to involve the trainee in the whole process of planning a job. Without this skill, trainees are unlikely to be able to use their practical skills to best effect in any situation. This is why the emphasis in assessment is not on practical skills, which will doubtless be thoroughly covered elsewhere in work experience and occupational training.

SUMMARY

Trainees are required to:

- plan and draw circuit diagrams;
- use equipment and tools to prepare printed circuit boards;
- use an oscilloscope and probes;
- calculate the cost of a parts 'kit';
- write a technical report.

SUPERVISOR'S NOTES

INTRODUCTION

This work-based project is designed to focus the trainee upon the core skill areas of: number, communication, practical skills and problem-solving. Wherever possible, it is also designed to provide learning opportunities to improve personal effectiveness, to provide wider knowledge of the world of work and elsewhere and to furnish the trainee with skills which can be transferred to other situations.

The essence of the work-based project is that people learn more quickly and effectively by actually doing something.

The following notes are designed to help you, your staff, and the trainee, so that the project can be carried out with a minimum of disruption to normal work activity:

1. Where appropriate, please advise other staff that the trainee will be doing the project.

2. Please ensure that the trainee has read the project details and understands what is required.

3. Please ensure that the trainee is aware of any aspects of safety, hygiene or security which might touch upon the project.

4. Please ensure that the trainee appreciates that good planning will make the task easier. Wherever possible, and before the project starts, the trainee should be encouraged to take responsibility for his/her learning by estimating time, deciding on equipment and materials, identifying possible hazards and other problems, and generally "thinking the project through".

5. When the project is complete discuss with the trainee the activities he/she has been engaged in. What problems were there? What has he/she learnt? Would he/she tackle the project differently a second time?

6. Encourage the trainee to complete the Trainee's Review page.

ADDITIONAL NOTES

1. Ask the trainee to show you his/her planned sequence of operations and estimate of time required to complete the project. Discuss any discrepancies and the problems likely to arise from its implementation.

2. Ask the trainees to show you the circuit diagram which has been produced at Stage 5 before proceeding to Stage 6.

3. Check the mask produced by the trainee before he/she produces the PCB.

4. Ensure that the trainee has put on protective clothing before using the etching tank.

5. Provide the trainee with a current parts catalogue and an order/requisition pad.

6. If an order form has to be filled in, ensure that the trainee has listed the parts correctly to enable the order to be authorised. Check the arithmetic on the order.

7 Discuss the project with the trainee to ascertain

how difficult he/she found it;

what problems were encountered and how they were overcome;

how he/she felt about the responsibility of doing the job with minimum supervision;

how he/she would go about the task if given a similar project in the future (assuming that some problems had been encountered);

what suggestions he/she would make to improve the project brief for another trainee.

MATERIALS AND EQUIPMENT NEEDED

PCB board with layered resist of a size suited to the client's requirements.
Grid masking guide.
Acetate sheet.
Transfer sheets for transistor pads and lines.
Self-adhesive track tape.
Model maker's PCB power drill.
drill bits and drill stand.
Pen soldering iron.
Resist stripping tank.
Developing/washing/etching tank.
Exposure box.
Light box.
Oscilloscope and other test equipment such as probes, etc.

Names

TRAINEE .....

SUPERVISOR .....

TUTOR .....

Times

Please fill in the table below. This will show the time you spend on completing this project. The first column has been filled in as an example. Make another table if you need more space

BACKGROUND

A small local firm wants a small quantity of Printed Circuit Boards but does not have the facilities to make its own, although it is capable of assembling components on the Boards to be provided by the ITeC

The firm has supplied a circuit diagram and has specified the qualities of test signals required from the assembled boards

SITUATION

In an ITeC

ACTION PLAN

BEST COPY AVAILABLE

Read right through this Action Plan and make sure that you completely understand what is expected of you by discussing it with your supervisor.

1. Examine the customer's circuit diagram and test specification.
2. Produce a 'kit' parts list.
3. Check that the components required are available in the stores. If they are not in stock look up the relevant references in the parts catalogue and make out an order for them.
4. Draw up a sequence of operations for the project and estimate how long the project will take to complete. As you do the project, record the actual time taken for each stage on your sequence plan.
5. Set out the PCB diagram on plan paper to get the best possible circuit. Black in your final diagram so that it is suitable for using on the light box.
6. Produce the mask using a transister pad transfer sheet and self-adhesive tape strips.
7. Select the appropriate PCB with layered resist and find out the correct exposure time from the manufacturer's recommendations.
8. Expose, develop and etch the Board using standard operating procedures.
9. Draw the components from stores, select the appropriate drills and machine the Board. Assemble and solder the components in position.
10. Decide on test procedures and test the circuit.
11. Using the parts list produced at stage 2, look up the price of all components in a current catalogue and work out the cost of the kit of parts.
12. Write a report of the project, setting out:

    the equipment used; time and temperature settings; test methods and readings obtained.

    Include in this report your estimated completion time and sequence of operations plan from stage 4, your original layout and mask and the parts list and price for the 'kit'.

    State how your planned sequence differed from that actually used.

    Describe any problems you encountered and how you overcame them.

PURPOSES

Doing this project will enable you to learn about the manufacture and testing of printed circuit boards. It will also help you to develop your CORE SKILLS in number, communication, problem-solving, and practical activities. Developing these skills will make it easier for you to adapt to changes in your job, and to retrain when the need arises.

The tasks you are asked to do are outlined below, together with the most important core skills that they contain. When you have finished each task, ask your supervisor to tell you how well he/she thought you did in the task, and record this on the Assessment Form near the back of this project. This record will be needed to complete your certificate at the end of your YTS year.

Task	Core skills	
1. Examine a circuit diagram and test specification.	Interpret diagrams and pictorial representations.	2.2
2. Produce a 'kit' parts list.	Interpret numerical data.	2.1
3. Check the availability of components in stock and order more if necessary.	Monitor the availability of stocks or materials.	11.3
4. Draw up a sequence of operations and estimate the time needed to complete them.	Estimate time needed. Plan the order of activities.	3.6 9.1
5. Make a diagram of the best possible circuit.	Plan the arrangement of items.	9.4
6. Produce a mask using a transistor pad.	Mark out required dimensions and shape.	4.2
7. Select a PCB and find out the correct exposure time.	Find information from written sources.	6.2
8. Exposure, develop and etch the board.		
9. Machine the board, assemble and solder the components into position.		
10. Decide on procedures to test the circuit.	Decide between alternative courses of action.	10.3
11. Work out the cost of the kit.	Work out numerical information.	1.2
12. Write a report of the work.	Provide information in writing.	7.3

TRAINEE REVIEW

PLEASE COMPLETE THIS FORM IN AS MUCH DETAIL AS POSSIBLE AND DISCUSS IT WITH YOUR SUPERVISOR AND TUTOR.

1. What did you think of this project? Was it easy or hard, interesting or boring?

2. What did you learn? (Look back at the list of Purposes to see what you were supposed to learn.)

3. Did you learn anything which was not on the list of Purposes?

4. Did you need help with any particular part of the project?
   What kind of help did you get?

5. How do you think you could use what you learned in another job, or outside work?

6. Has this project helped you decide whether you need further training in certain areas?

SUPERVISOR REVIEW

Please refer to Supervisor's Notes.

Please read the questions included under Trainee Review.

Please complete the Assessment Form and discuss your assessment with the trainee before initialling it to show that you both agree with the assessment.

COMMENTS:

ASSESSMENT
explanatory notes

In completing this W B P. the trainee has the opportunity to demonstrate competence in the core skills listed on the attached form.

The first two columns list the WBP tasks and core skills which occur within them.

You are asked to assess the trainee's competence in these core skills according to the amount of support from you that the trainee needed, for example:

1. If a trainee is asked to "find information from written sources" and you provide the trainee with all the sources of that information, together with telling the trainee where to look in any particular sources, then that trainee is obviously being given much more support in finding that information than a trainee who identifies the sources and extracts correct information unaided:

2. If a trainee is asked to undertake a task which involves "noticing the needs of customers or clients", and needs considerable prompting to approach a customer, then that trainee is obviously being given more support than a trainee who takes the initiative in approaching the customer.

To be regarded as fully competent in the core skills, the trainee should need to be offered no more support than you would normally give to any experienced worker.

Most of the time job competence and core skills competence are likely to be the same, but sometimes this may not be so. For instance, a trainee involved in machining a particular component may be competent so far as planning the work is concerned (a core skill) but may not have reached experienced worker speeds (an occupational skill).

Please tick the appropriate box and initial in the space provided, after you have discussed your assessment with the trainee and agreed any further training required.

ASSESSMENT FORM

PROJECT TITLE PRINTED CIRCUIT BOARD DESIGN AND PRODUCTION WBP NO DATE

TRAINEE'S NAME SUPERVISOR'S NAME

WBP TASK NO	CORE SKILLS ASSESSED	NEEDED A LOT OF ASSISTANCE	NEEDED SOME ASSISTANCE	LITTLE OR NO ASSISTANCE		COMMENTS: INCLUDING NO OPPORTUNITY	AGREED INITIALS	
				NEEDS MORE PRACTICE	COMPETENT		TRAINEE	SUPERVISOR
1	Interpret diagrams and pictorial representations. (2.2)							
2	Interpret numerical data. (2.1)							
3	Monitor availability of stock. (11.3)							
4	Estimate time needed for an activity. (3.6)							
	Plan the order of activities. (9.1)							
5	Plan the arrangement of items. (9.4)							
6	Mark out required dimensions. (4.2)							
7	Find out information from written sources. (6.2)							

ASSESSMENT FORM continued.

WBP TASK NO	CORE SKILLS ASSESSED	NEEDED A LOT OF ASSISTANCE	NEEDED SOME ASSISTANCE	LITTLE OR NO ASSISTANCE		COMMENTS: INCLUDING NO OPPORTUNITY	AGREED INITIALS	
				NEEDS MORE PRACTICE	COMPETENT		TRAINEE	SUPERVISOR
10	Decide between alternative courses of action. (10.3)							
11	Work out numerical information. (1.2)							
12	Provide information in writing. (7.3)							